Title: ELECTRONICALLY CONTROLLED HYDRAULIC BRAKE SYSTEM
Inventor(s): Jicheng ZHANG et al.
DOCKET NO.: 023971-0387

FIG.1

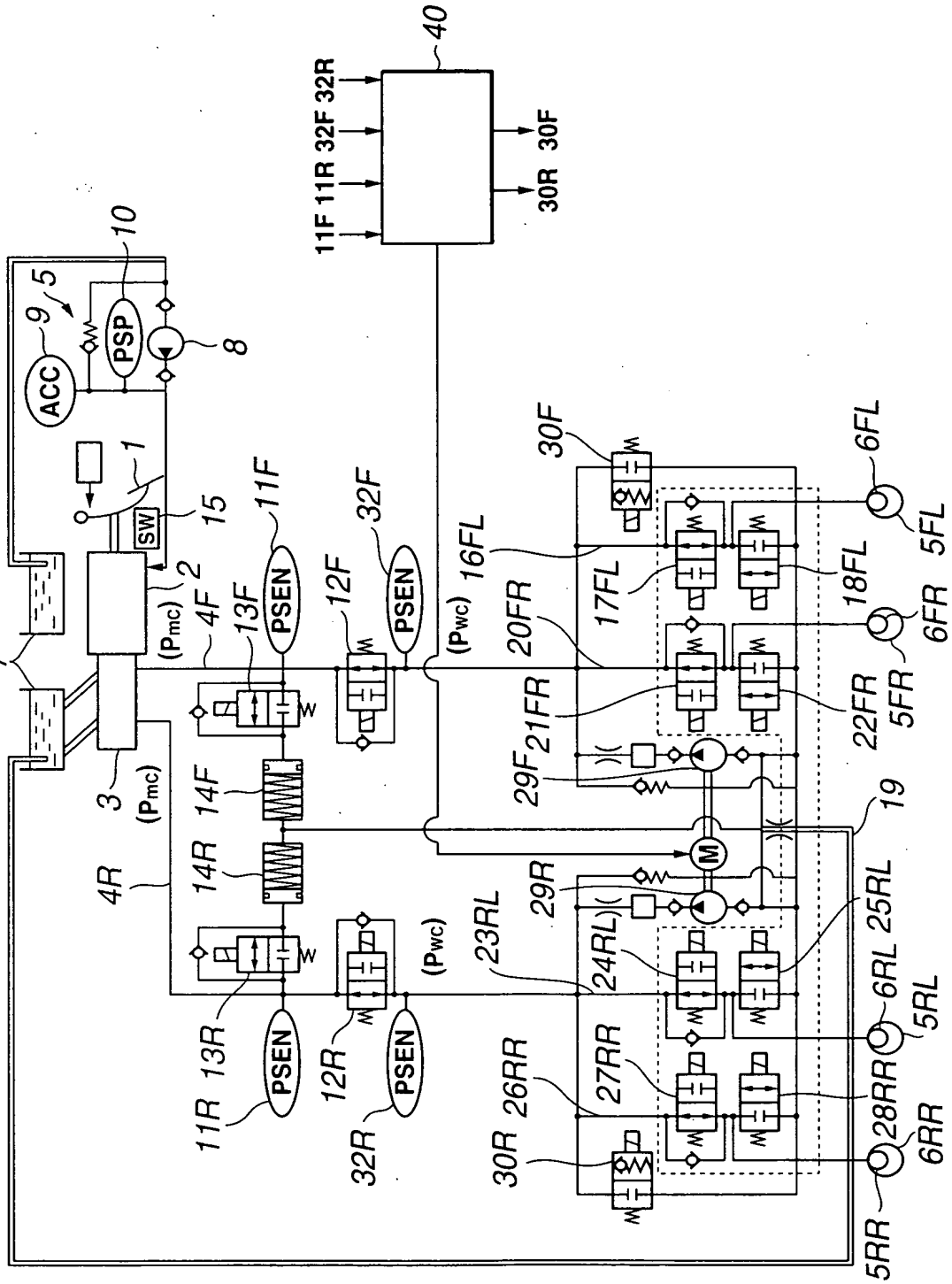
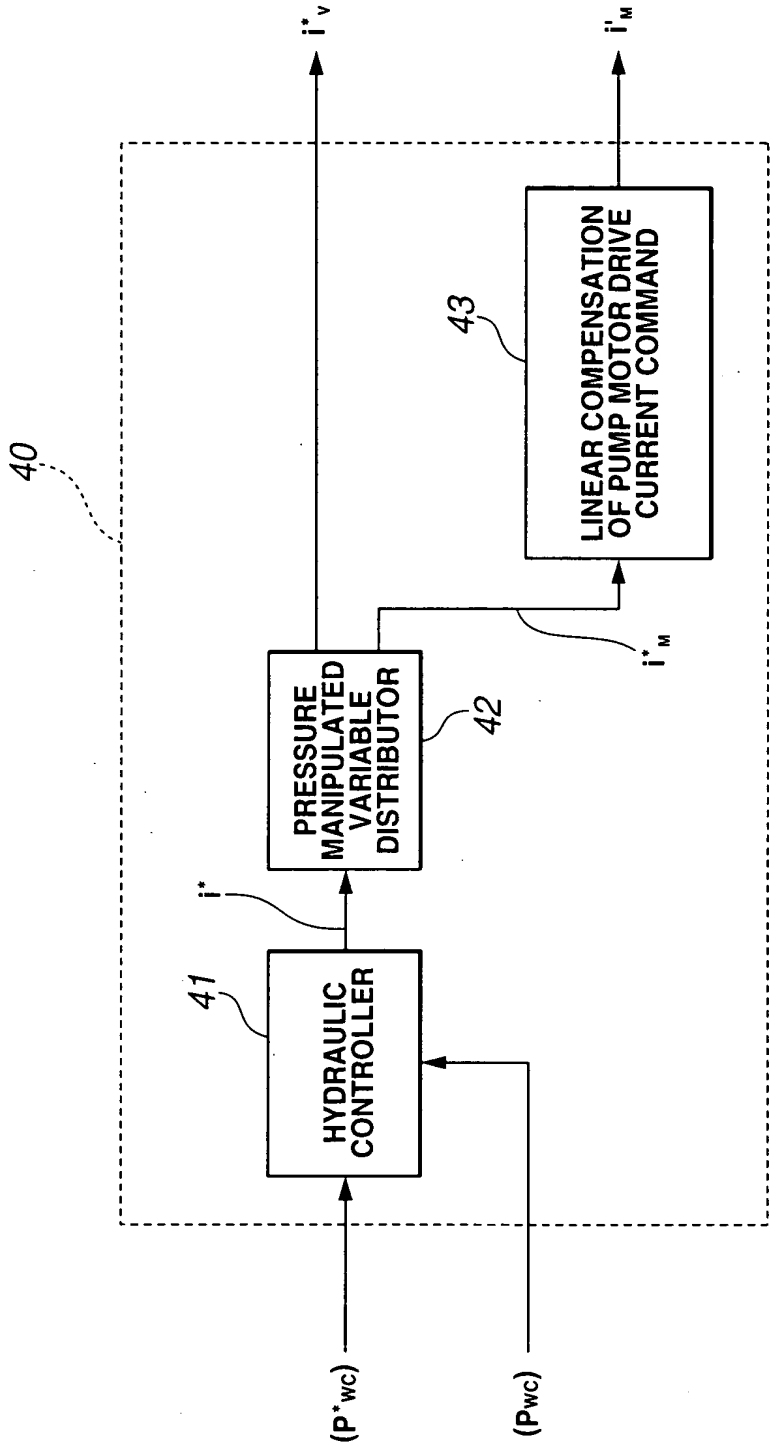


FIG.2


i*v
i'M
40
43
LINEAR COMPENSATION OF PUMP MOTOR DRIVE CURRENT COMMAND
i*M
PRESSURE MANIPULATED VARIABLE DISTRIBUTOR
42
i*
41
HYDRAULIC CONTROLLER
(P*wc)
(Pwc)

# FIG.3

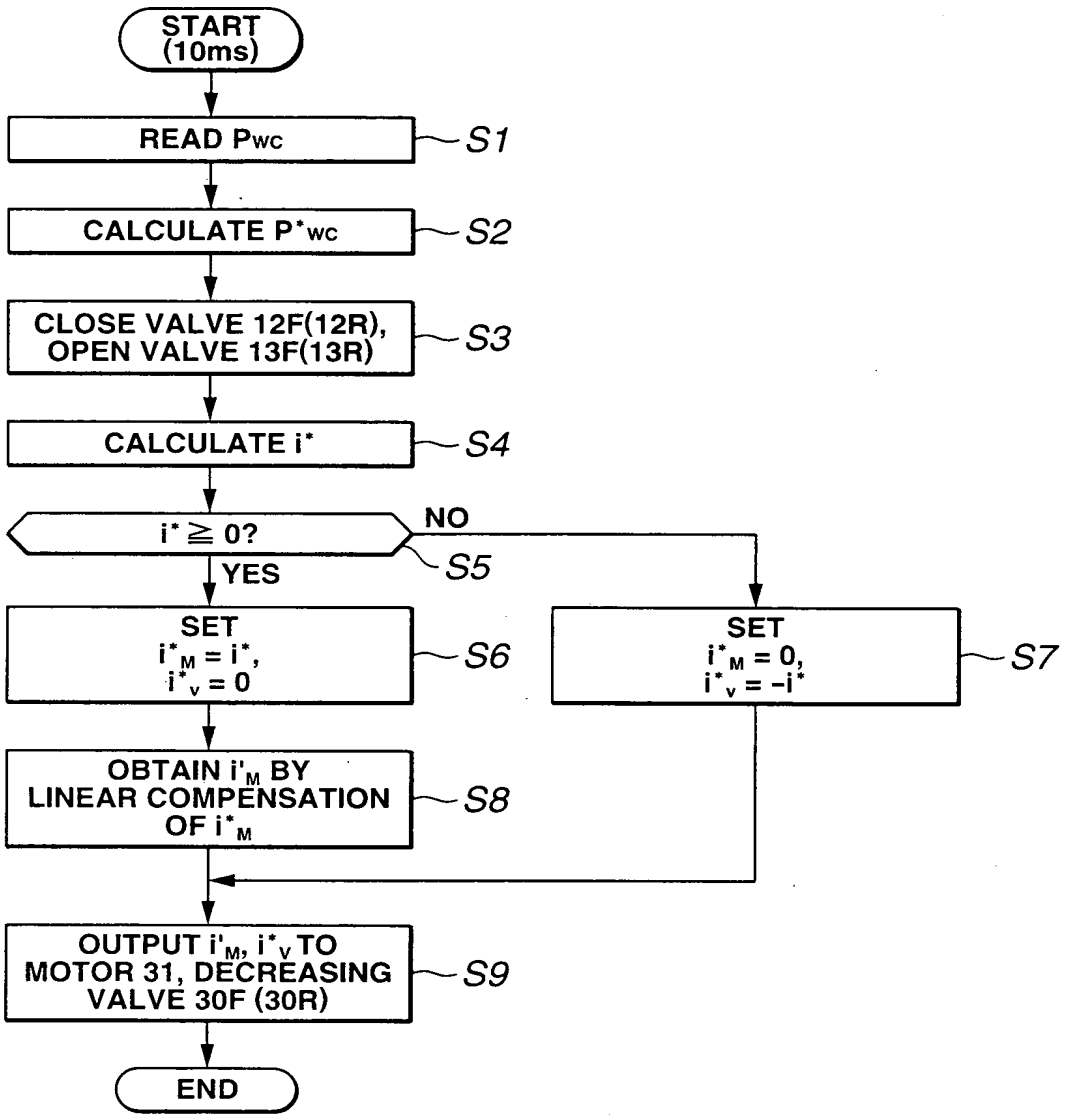
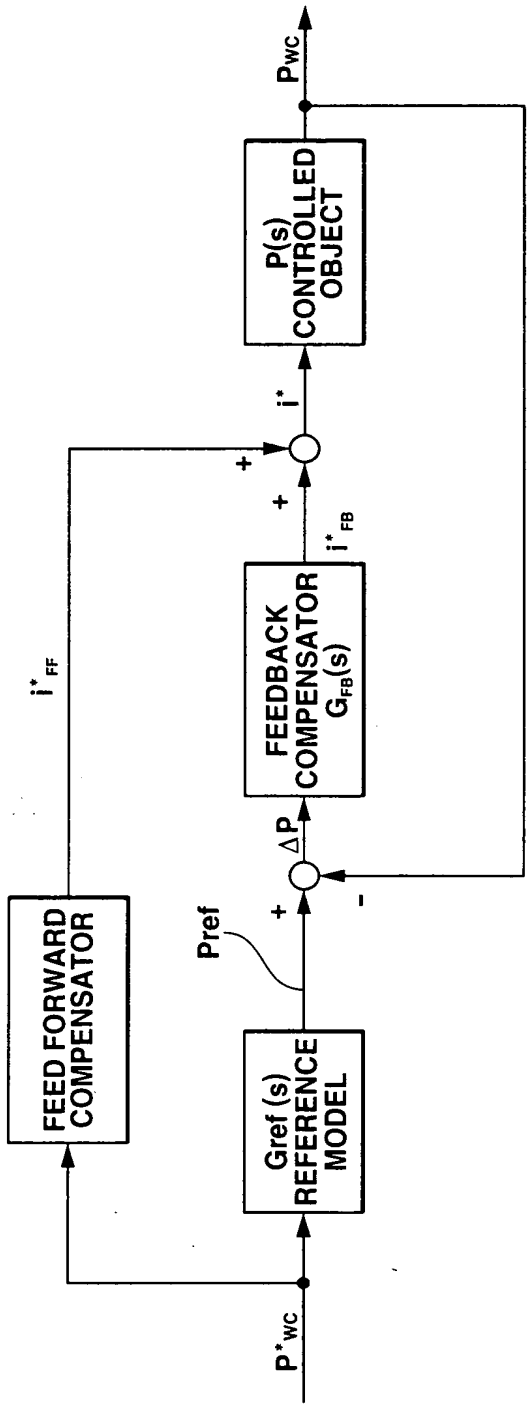

START
(10ms)
READ Pwc
S1
CALCULATE P*wc
S2
CLOSE VALVE 12F(12R),
OPEN VALVE 13F(13R)
S3
CALCULATE i*
S4
i* ≧ 0?
NO
S5
YES
SET
i*M = i*,
i*v = 0
S6
SET
i*M = 0,
i*v = -i*
S7
OBTAIN i'M BY
LINEAR COMPENSATION
OF i*M
S8
OUTPUT i'M, i*v TO
MOTOR 31, DECREASING
VALVE 30F (30R)
S9
END

FIG.4


P*WC
Gref (s)
REFERENCE
MODEL
Pref
FEED FORWARD
COMPENSATOR
+
ΔP
-
FEEDBACK
COMPENSATOR
GFB(s)
i*FB
+
+
i*FF
i*
P(s)
CONTROLLED
OBJECT
PWC

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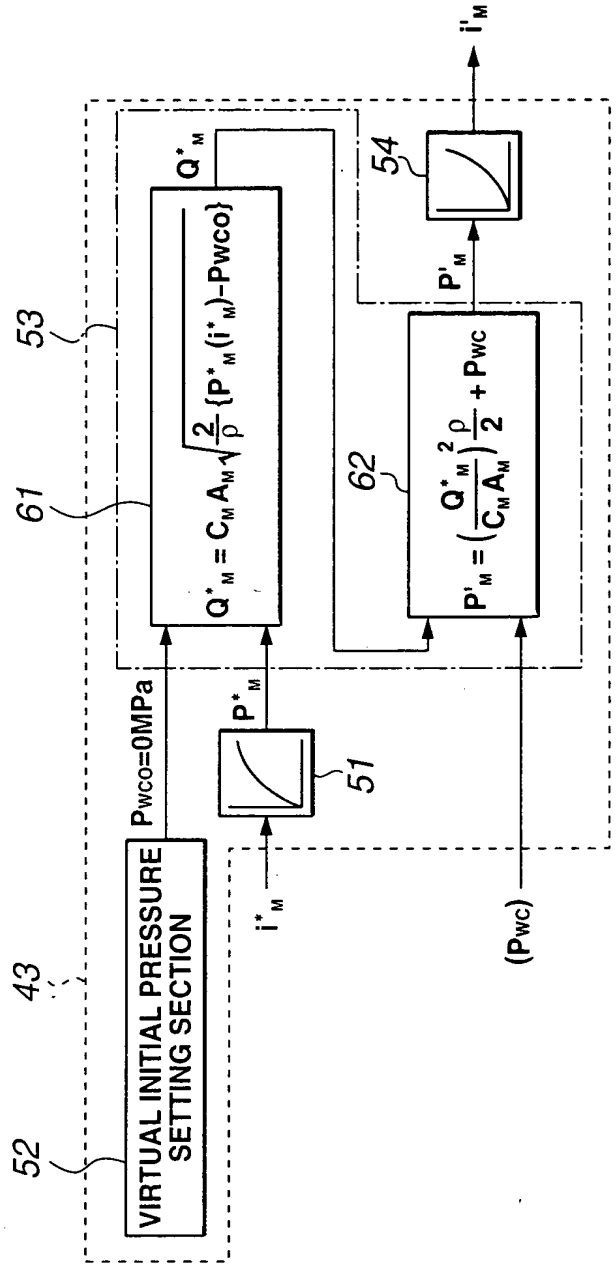


FIG.5A

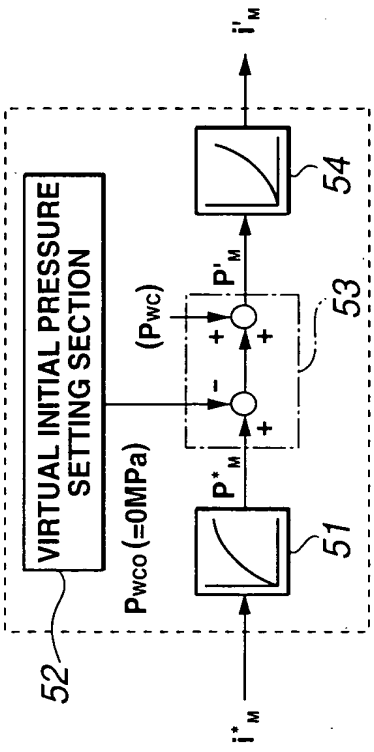


FIG.5B

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FIG.6

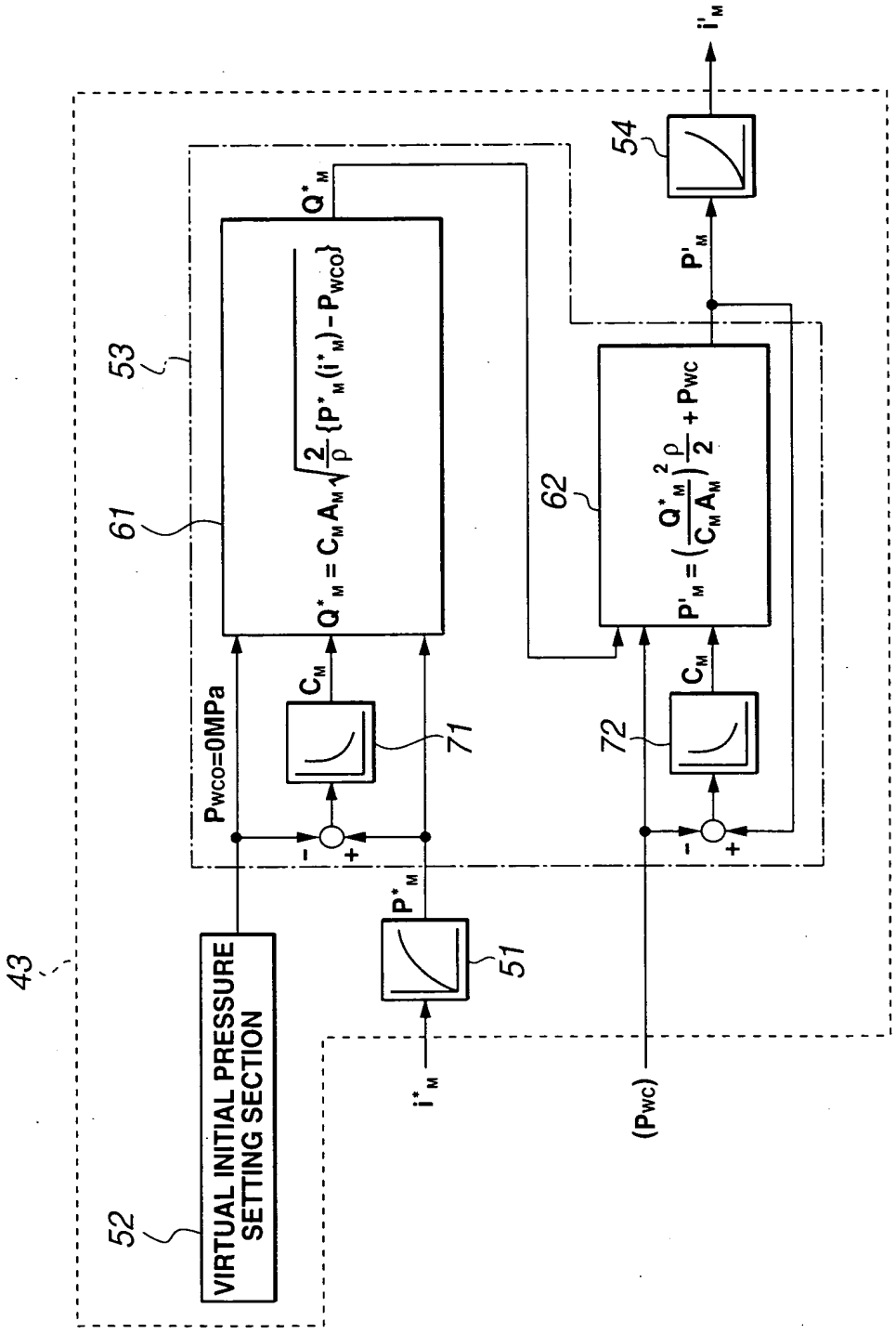


FIG.7

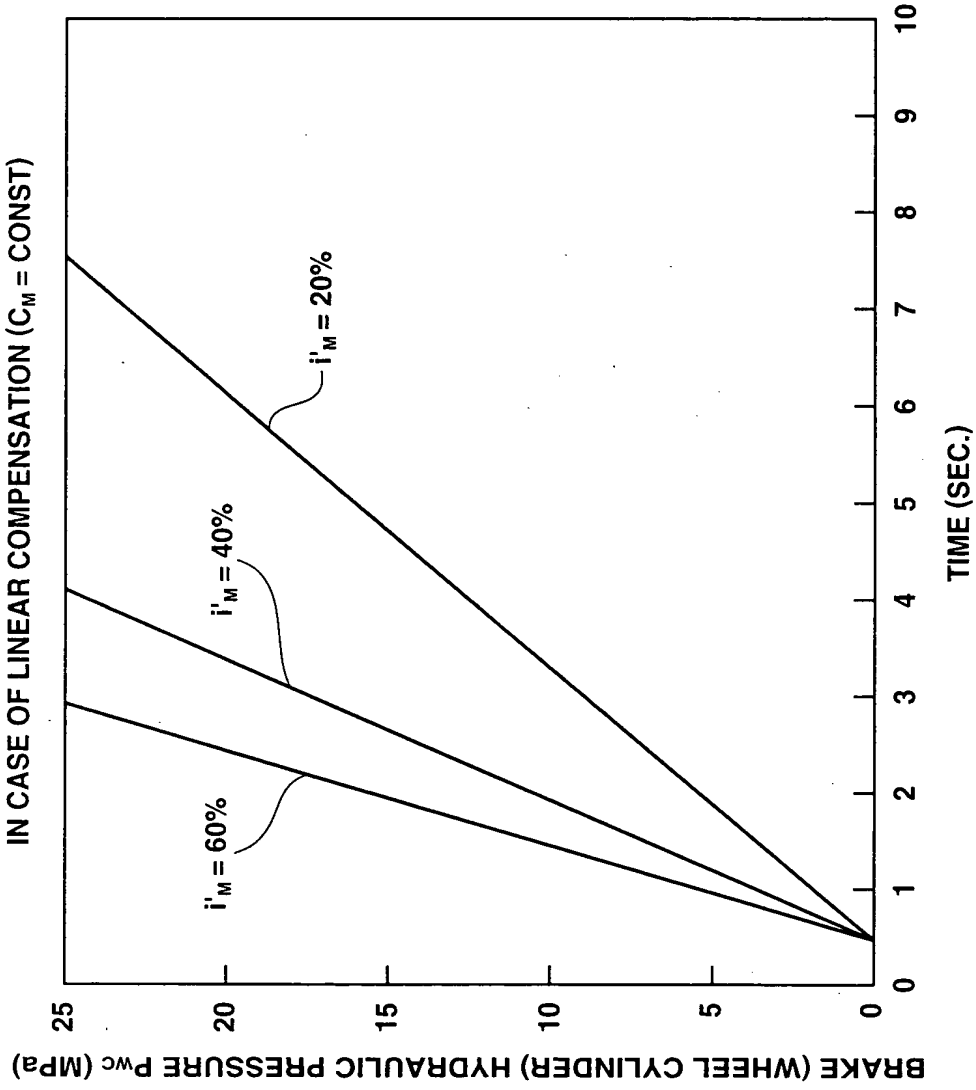

IN CASE OF LINEAR COMPENSATION ($C_M$ = CONST)
BRAKE (WHEEL CYLINDER) HYDRAULIC PRESSURE $P_{WC}$ (MPa)
TIME (SEC.)
$i'_M$ = 20%
$i'_M$ = 40%
$i'_M$ = 60%
0
5
10
15
20
25
0
1
2
3
4
5
6
7
8
9
10

FIG.8

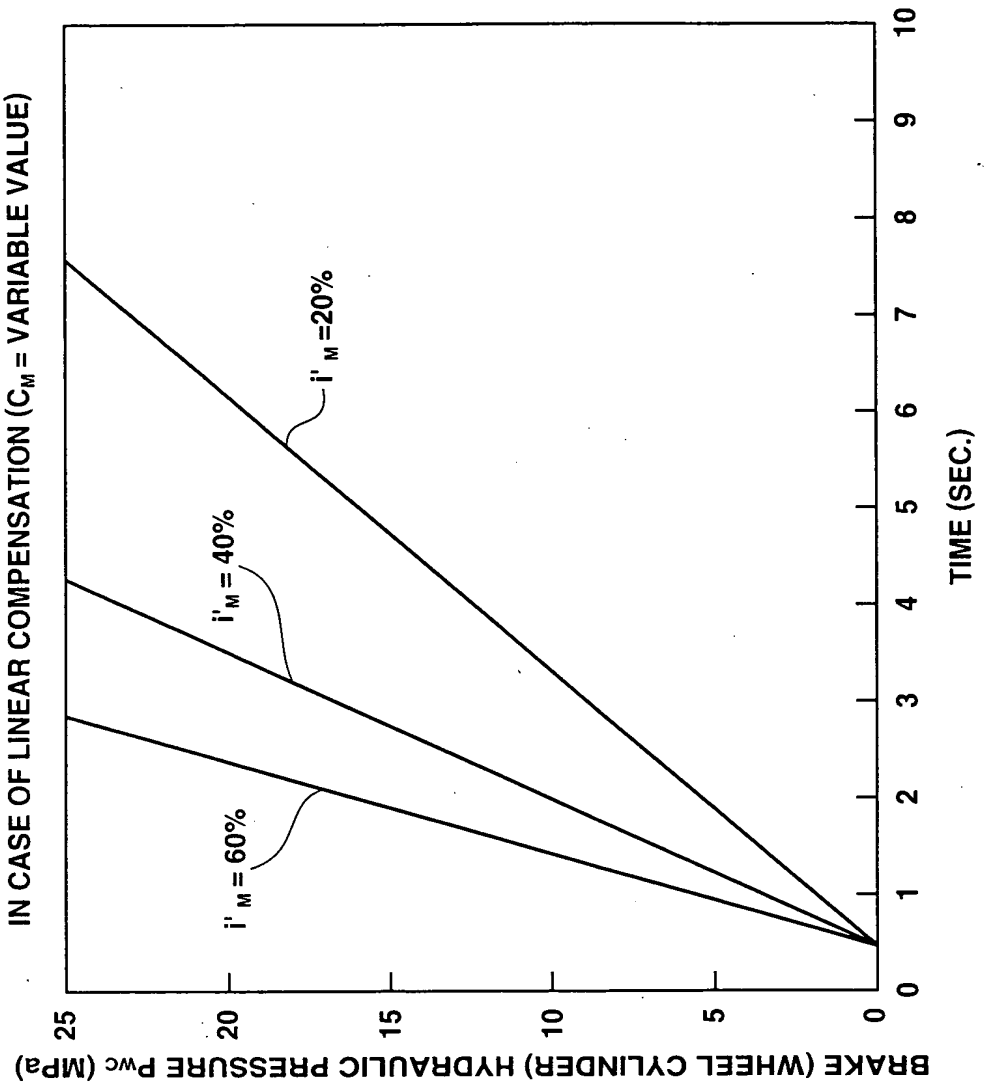
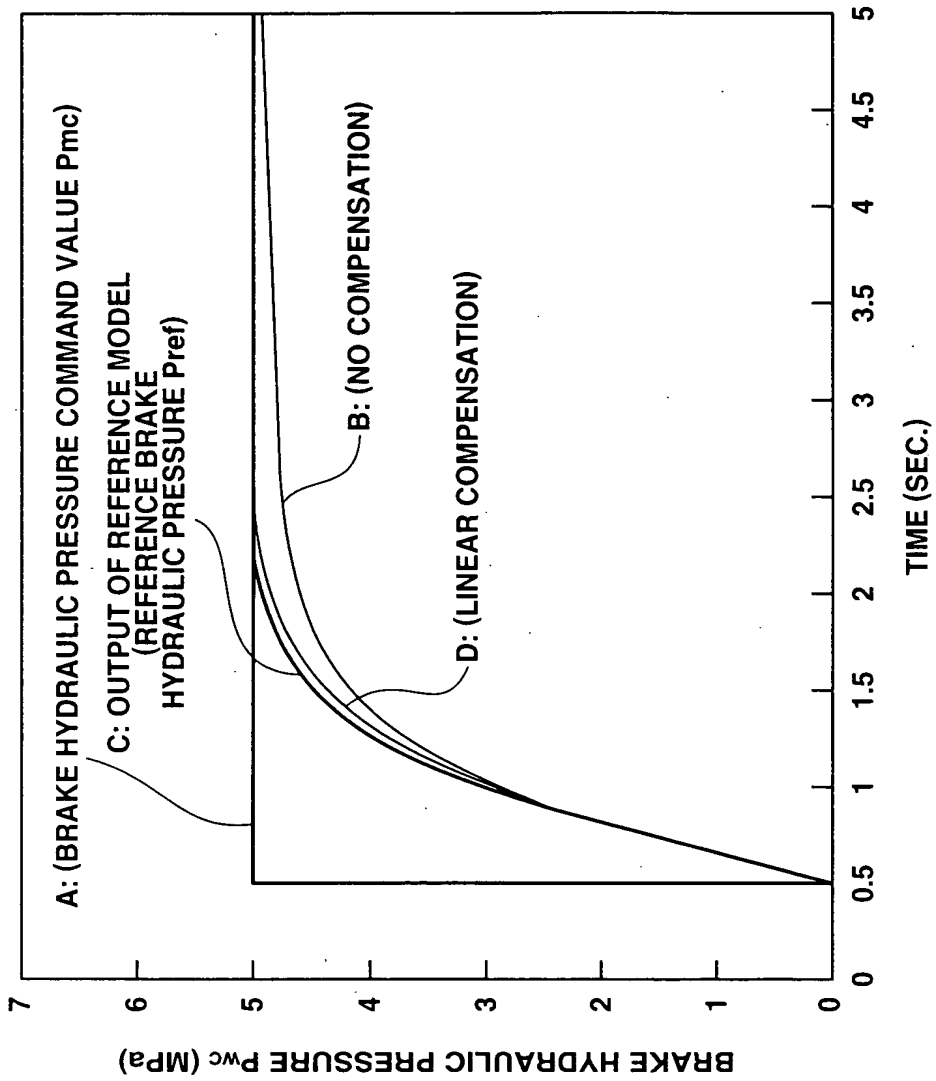

IN CASE OF LINEAR COMPENSATION ($C_M$ = VARIABLE VALUE)
BRAKE (WHEEL CYLINDER) HYDRAULIC PRESSURE $P_{WC}$ (MPa)
TIME (SEC.)
$i'_M$ = 20%
$i'_M$ = 40%
$i'_M$ = 60%
0
5
10
15
20
25
0
1
2
3
4
5
6
7
8
9
10

FIG.9


A: (BRAKE HYDRAULIC PRESSURE COMMAND VALUE Pmc)
C: OUTPUT OF REFERENCE MODEL
(REFERENCE BRAKE
HYDRAULIC PRESSURE Pref)
B: (NO COMPENSATION)
D: (LINEAR COMPENSATION)
BRAKE HYDRAULIC PRESSURE Pwc (MPa)
TIME (SEC.)
0
1
2
3
4
5
6
7
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

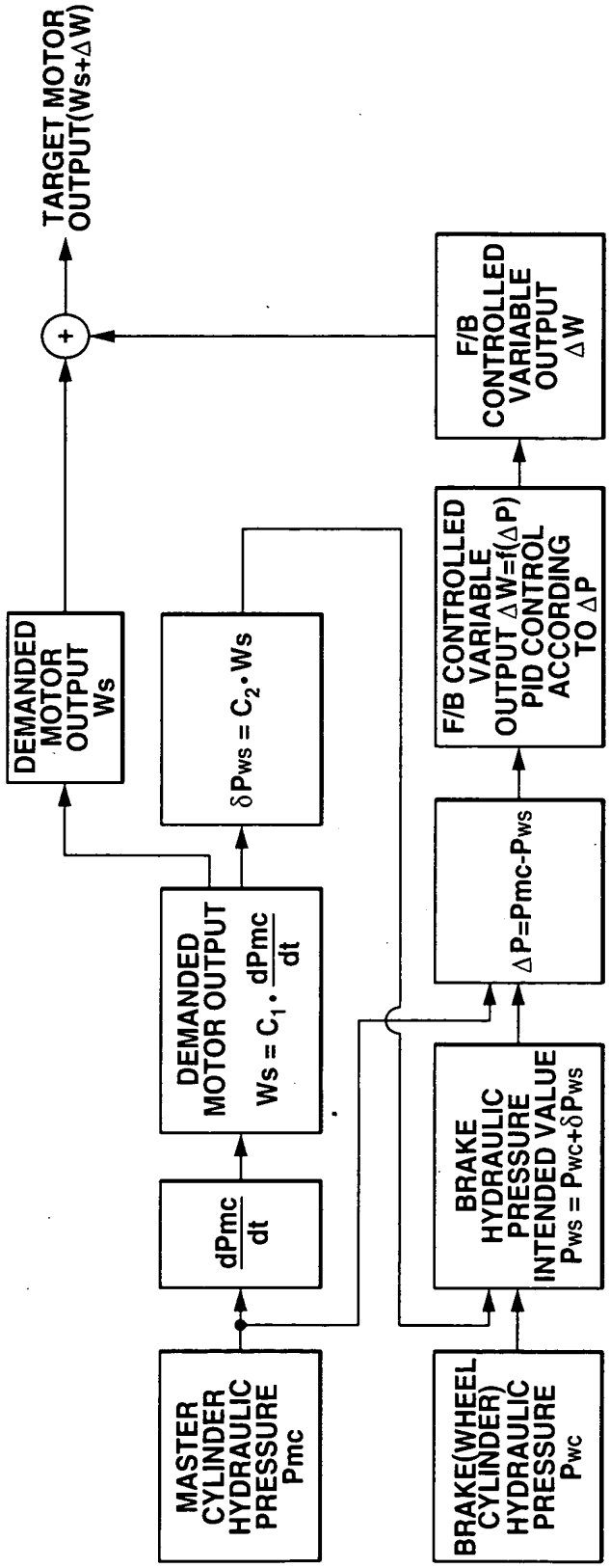
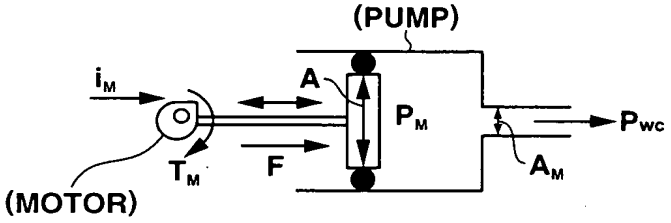



FIG.10
(RELATED ART)

# FIG.11




$i_M$: PUMP DRIVE MOTOR CURRENT [A] (PROPORTION TO DUTY RATIO)

$T_M$: PUMP DRIVE MOTOR AXIAL TORQUE [N·s]

F: FORCE APPLIED TO CROSS-SECTION A [N]

A: PISTON CROSS SECTIONAL AREA [$m^2$]

$P_M$: ORIFICE UP STREAM PRESSURE [MPa] (PROPORTION TO PISTON INNER PRESSURE, PUMP DRIVE MOTOR CURRENT)

$P_{wc}$: ORIFICE DOWN STREAM PRESSURE [MPa] (HYDRAULIC PRESSURE)

$A_M$: PUMP ORIFICE OPENING CROSS-SECTION [$m^2$]

$Q_M$: PUMP VOLUMETRIC FLOW RATE [$m^3/s$]

$C_M$: PRESSURE INCREASING SIDE FLOW RATE COEFFICIENT

$Q_M$: FLUID DENSITY [$kg/m^3$]

PUMP FLOW RATE MODEL :

$$Q_M = C_M A_M \sqrt{\frac{2}{\rho}\{P_M(i_M) - P_{wc}\}}$$

# FIG.12
## (RELATED ART)